

Tennessee Schools Lab Rehab Program

Green Chemistry 101

Chemical Safety,
Management, and
Storage



Tennessee Schools Lab Rehab Program

What is TSLRP?

- **Educational Webinar**
 - Green chemistry
 - Chemical safety practices
 - Hazardous waste management
 - Next steps
- **Free, one-time disposal of hazardous waste**
 - Science labs
 - Vocational facilities
 - Nurse's offices
 - Custodial supplies

Green Chemistry 101

Green Chemistry 101

- What is Green Chemistry?
 - Overview of Green Chemistry
 - 12 Principles of Green Chemistry
 - Prevent Waste
 - Accident Prevention
- Safety and Management
 - Chemical Hygiene Plan
 - Inventory
 - Safety Data Sheets
- Storage
 - Storage Hardware
- Curriculum Resources

Overview of Green Chemistry

- Developed by United States Environmental Protection Agency (EPA) in the 1990s
- Definition: the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances
- Approach to chemistry **that prioritizes pollution and hazard prevention**
 - Minimizes energy use, resource use, and waste
- Green Chemistry can reduce costs!
 - Rule of thumb: Disposal costs 10x purchase price for hazardous materials
 - Lower chance of costly accident and clean up

12 Principles of Green Chemistry

The 12 Principles of Green Chemistry

A framework for designing or improving materials, products, processes and systems.

1. Prevent Waste
2. Atom Economy
3. Less Hazardous Synthesis
4. Design Benign Chemicals
5. Benign Solvents & Auxiliaries
6. Design for Energy Efficiency
7. Use of Renewable Feedstocks
8. Reduce Derivatives
9. Catalysis (vs. Stoichiometric)
10. Design for Degradation
11. Real-Time Analysis for Pollution Prevention
12. Inherently Benign Chemistry for Accident Prevention

Prevent Waste

- “An ounce of prevention is better than a pound of cure”

- Minimize volumes involved with experiments and demonstrations



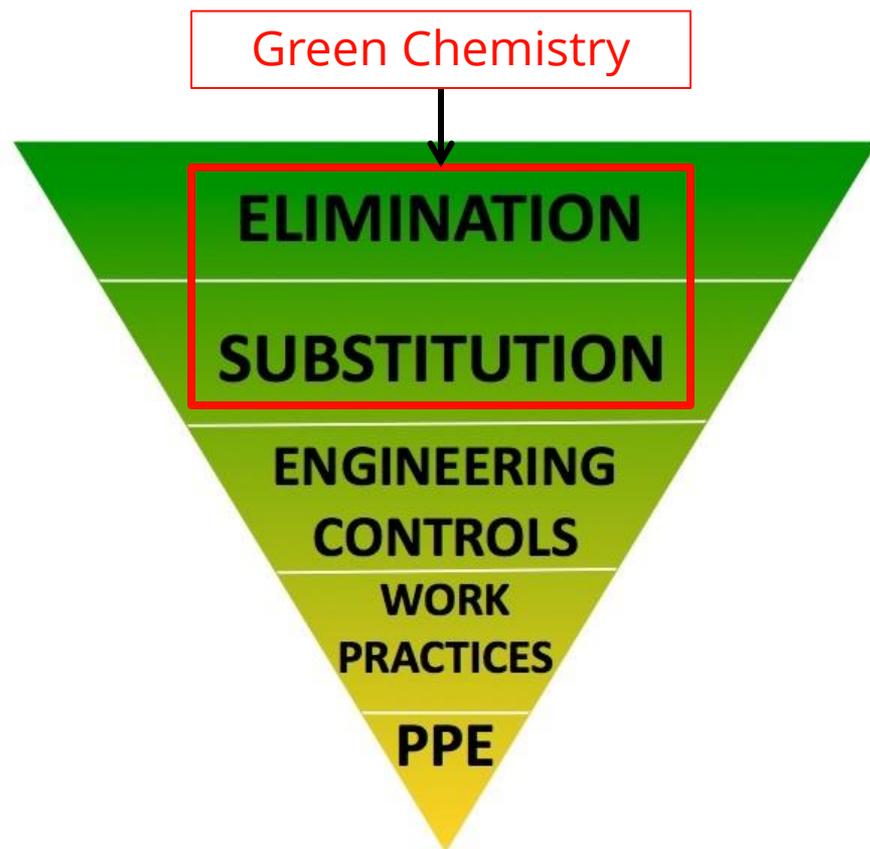
vs.



- Responsible purchasing
 - Maintain inventory of materials, their amounts, and how long they will last
 - Limited quantities—don't buy in bulk for the discount!
 - Coordinate with other teachers and nearby schools to ensure efficient purchasing

Inherently Benign Chemistry for Accident Prevention

- PPE is the bottom rung on the safety ladder
- Preferable to limit exposure
- Substitute non-hazardous materials where possible
 - Use drinkable liquids to learn about pH
 - Salt and sugar to learn about ionic and covalent bonds



Safety, Management, and Storage

Safety and Management

- Chemical Hygiene Plan
 - Required by [29 CFR 1910.1450\(e\)](#) (OSHA)
- Update chemical inventory at least annually
 - What's in stock? Where is it? How much is there?
 - [TDLWD Rule 0800-01-09-.11\(1\)](#) Workplace Chemical List
- Provide inventory and contact info of responsible party to local emergency responders
 - Fire Department and County Emergency Medical services



Safety and Management

- Store all chemicals in their original containers
 - Labels required to comply with [29 CFR 1910.1200\(f\)](#)
 - Be sure it has the *name* of the chemical, not just the formula



vs.



- Be familiar with storage, handling, and disposal requirements
 - This info can be found on each chemical's Safety Data Sheet

Safety Data Sheets (SDS)

- Required by TDLWD Rule 0800-01-09-.01(1)(a)
- Manufacturer required to provide them by 29 CFR 1910.1200(g)(1) (OSHA)
- Important information:
 - **Section 1: Identification**
 - **Section 2: Hazard identification**
 - Section 4: First-aid measures
 - Section 7: Handling and storage



SAFETY DATA SHEET

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Hydrochloric Acid, 31 – 36%

Product Name: Hydrochloric Acid, 31 – 36.7%

Identified Uses: acid etching, steel pickling, oil and gas, ore and mineral, food processing, pharmaceutical, organic chemical synthesis

Company Information:

ASHTA Chemicals Inc.

P.O. Box 858

Ashtabula Ohio 44005

Phone: (440) 997-5221

Fax: (440) 998-0286

24-hour Emergency Phone: CHEMTREC: (800) 424-9300

SECTION 2: HAZARDS IDENTIFICATION

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

GHS label elements, including precautionary statements:

Signal Word: **Danger**

Pictogram(s):



Safety Data Sheets (SDS)

- Important information:
 - Section 1: Identification
 - Section 2: Hazard identification
 - **Section 4: First-aid measures**
 - **Section 7: Handling and storage**

SECTION 4

FIRST AID MEASURES

Description of first aid measures:

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. If breathing is difficult, give humidified air. Give oxygen, but only by a certified physician. Consult a physician.

In case of skin contact

Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Remove contact lenses if present and easy to do. Continue rinsing eyes during transport to medical facility.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth thoroughly with water. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Consult a physician.

SECTION 7:

HANDLING AND STORAGE

Precautions to be taken for handling and storage:

Wear appropriate personal protective equipment. Do not get in eyes, on skin, on clothing. Do not breathe mist or vapor. Observe good industrial hygiene practices. Do not empty into drains. Use caution when combining with water; DO NOT add water to acid, ALWAYS add acid to water while stirring to prevent release of heat, steam and fumes. Store in a well-ventilated place. Store away from incompatible materials. Store closed containers in a clean, cool, open or well ventilated area. Keep out of sun.

Safety Data Sheets (SDS)

Material Safety Data Sheet

FLINN SCIENTIFIC INC.

"Your Safer Source for Science Supplies"

Material Safety Data Sheet (MSDS)

MSDS #: 11000

Revision Date: November 25, 2002

Section 1 — Chemical Product and Company Identification

Cellulose Acetate

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261
CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Cellulose Acetate

CAS#: 9004-35-7

Section 3 — Hazards Identification

White flakes or powder. Odorless.
Substance ~~not~~ considered hazardous. However, not all health aspects of this substance have been thoroughly investigated. Avoid any source of ignition. Moderate fire risk.

FLINN AT-A-GLANCE
Health-0
Flammability-1
Reactivity-0
Exposure-0
Storage-0

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash with soap and copious amounts of water.
Internal: Give large quantities of water. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Combustible solid.
Moderate fire hazard. When heated to decomposition, emits toxic fumes of carbon monoxide and carbon dioxide.
Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
None Established

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Sweep up, place in sealed bag or container and dispose. Ventilate area and wash spill site after material pickup is complete. See Sections 3 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Organic #3. Store with hydrocarbons, esters and aldehydes.
Store in a cool dry place. Keep container tightly closed.

Section 8 — Exposure Controls, Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron.

(new) Safety Data Sheet

FLINN SCIENTIFIC, INC. Safety Data Sheet (SDS)

SDS #: 181.00

Revision Date: September 25, 2013

SECTION 1 — CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

n-Butyl Alcohol

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261
CHEMTREC Emergency Phone Number: (800) 424-9300

Signal Word DANGER

SECTION 2 — HAZARDS IDENTIFICATION

Hazard class: Flammable liquids (Category 3). Flammable liquid and vapor (H226). Keep away from heat, sparks, open flames, and hot surfaces. No smoking (P210).

Hazard class: Acute toxicity, oral (Category 4). Harmful if swallowed (H302). Do not eat, drink or smoke when using this product (P270).

Hazard class: Skin corrosion or irritation (Category 2). Causes skin irritation (H315).

Hazard class: Serious eye damage/eye irritation (Category 1). Causes serious eye damage (H318).

Hazard class: Specific target organ toxicity, single exposure; respiratory tract irritation (Category 3). May cause respiratory irritation (H335).

Hazard class: Specific target organ toxicity, single exposure; Narcotic effects (Category 3). May cause drowsiness or dizziness (H336). Avoid breathing mist, vapors or spray (P261).



SECTION 3 — COMPOSITION, INFORMATION ON INGREDIENTS

Component Name	CAS Number	Formula	Formula Weight	Concentration
n-Butyl alcohol	71-36-3	CH ₃ (CH ₂) ₃ OH	74.12	

Synonym: 1-Butanol; n-Butanol

SECTION 4 — FIRST AID MEASURES

Call a POISON CENTER or physician if you feel unwell (P312).

If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing (P304+P340).

If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing (P305+P351+P338).

If on skin (or hair): Immediately remove all contaminated clothing. Rinse skin with water (P303+P361+P353).

If swallowed: Rinse mouth. Call a POISON CENTER or physician if you feel unwell (P302+P301+P312).

SECTION 5 — FIRE FIGHTING MEASURES

Class 1C flammable liquid.

Flash point: 37 °C Flammable limits: Lower: 1.4% Upper: 11.2% Autoignition Temperature: 343 °C

When heated to decomposition, may emit CO and CO₂.

In case of fire: Use triclass dry chemical fire extinguisher (P370+P378).

NFPA CODE
H-2
F-3
R-0



8 parts

16 parts

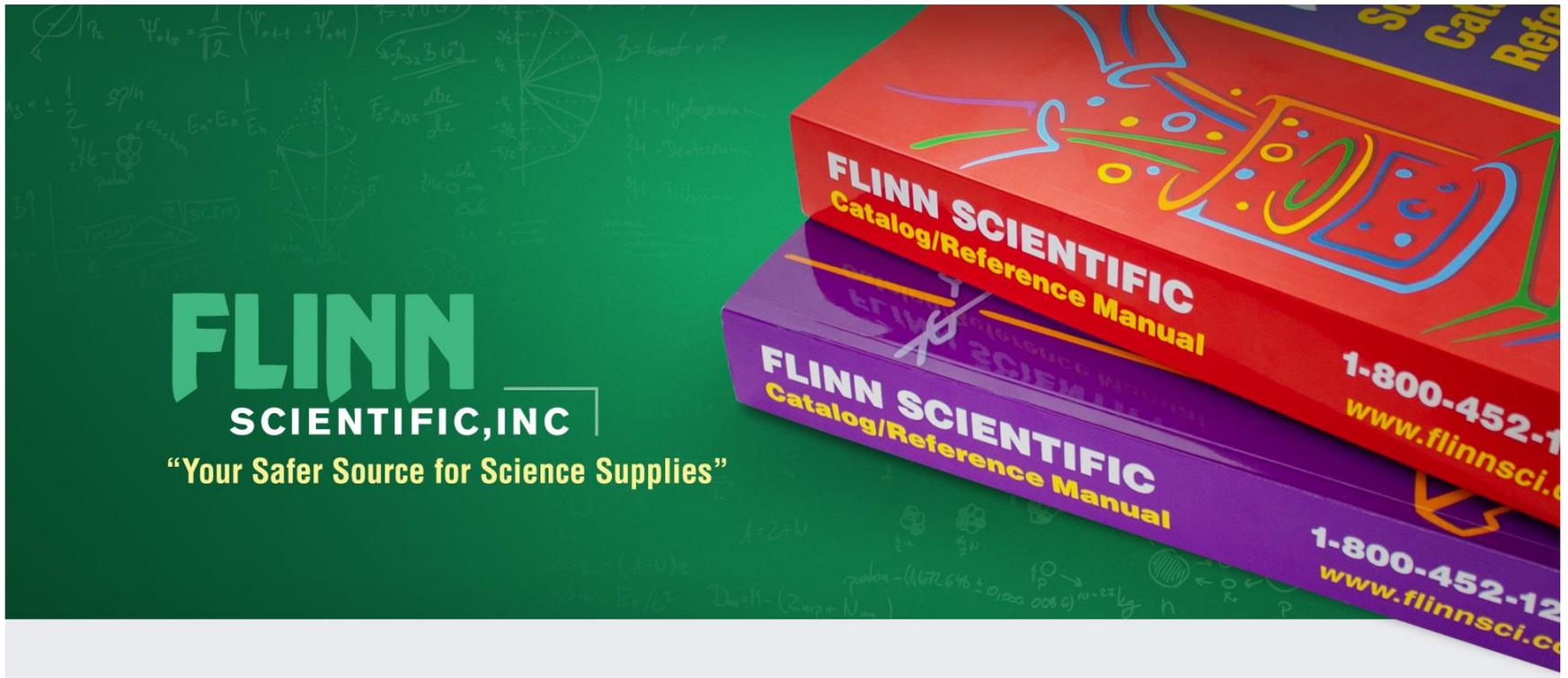
Be sure you have the most updated SDS in a central, easily accessible location.

TN

Department of
Environment &
Conservation

Storage

Flinn Science Catalog Reference Manual



Request a free Manual from Flinn Scientific

Storage

Flinn Science Catalog Reference Manual

I-1	Metals, Hydrides
I-2	Acetates, Halides, Iodides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Oxalates, Phthalates, Oleates
I-3	Amides, Nitrates (except ammonium nitrate), Nitrites, Azides
I-4	Hydroxides, Oxides, Silicates, Carbonates, Carbon
I-5	Sulfides, Selenides, Phosphides, Carbides, Nitrides
I-6	Chlorates, Bromates, Iodates, Perchlorates, Chlorites, Hypochlorites, Peroxides, Perchloric Acid, Hydrogen Peroxide
I-7	Arsenates, Cyanides, Cyanates
I-8	Borates, Chromates, Manganates, Permanganates, Molybdates, Vanadates
I-9	Inorganic acids (except Nitric [isolated and stored by itself])
I-10	Sulfur, Phosphorus, Arsenic, Phosphorus pentoxide
I-11	Inorganic Miscellaneous
O-1	Organic acids, Amino acids, Anhydrides, Peracids
O-2	Alcohols, Glycols, Sugars, -amines, -imines, -imines, -imides
O-3	Hydrocarbons, Esters, Aldehydes, Oils
O-4	Ethers, Ketones, Ketenes, Halogenated hydrocarbons, Ethylene oxide
O-5	Epoxy compounds, Isocyanates
O-6	Peroxides, Hydroperoxides, Azides
O-7	Sulfides, Polysulfides, Sulfoxides, Nitriles
O-8	Phenols, Cresols
O-9	Dyes, Stains, Indicators
O-10	Organic Miscellaneous

- Based on chemical compatibility
 - Separate organic and inorganic substances
 - Further organized by families
- Acids cabinet
- Poisons cabinet
- Flammables cabinet
- Oxidizers cabinet

Storage Hardware



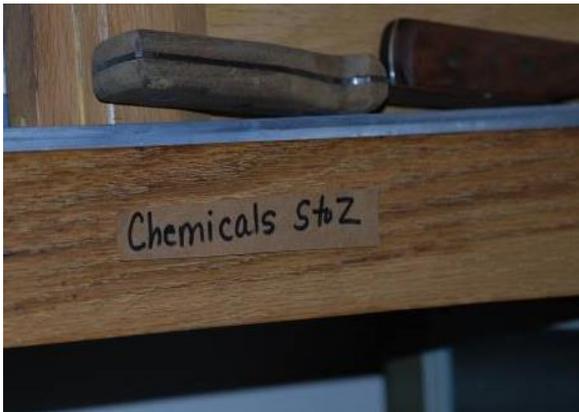
Acids



Flammables

If you can't get individual cabinets, physically separate materials by hazard type

How NOT to Store Chemicals



In alphabetical
order (A-Z)



Above eye level



Co-mingled

Curriculum and Management Resources

- [Beyond Benign K-12 Green Chemistry Ed.](#)
- [Union University's Green Chemistry Labs for High School](#)
- [American Chemical Society Green Chemistry Educational Resources](#)
- [Washington State Green Chemistry Resources](#)
- [OSHA 29 CFR 1910 Regulations Regarding Chemical Hygiene](#)
 - [Required Elements of Chemical Hygiene Plan](#)
- [TN Department of Labor and Workforce Development Rules](#)